Connecting Ecology, Landscape, Stormwater, Design and Planning

Debbie Reid, City Arborist
City of San Antonio
Planning and Development Services

Issues

- Urban sprawl and urban heat island
- Loss of open space with an average of less than 5 ac per 1,000 residents in Texas
- Failing infrastructure
- Air quality and energy supplies
- Flooding and water quality
- Loss of indigenous biodiversity, plants and animals with endangered local species and invasive exotic species
- Light and noise pollution
- Environmental injustices
- Vehicles take precedence over bikes and pedestrians
- Inadequate public transportation
- Loss of tree canopy
- Degraded creeks and river

What If …….

- We could stop the way we develop and live within our communities *today* and re-invent how we proceed from this point forward – what would we change? would we change?

"The object is to describe a new-reality that is compelling enough and positive enough to entice people to see freshly and change their habits"

Leslie Jones Sauer in The Once and Future Forest

Creating the "New Reality" for San Antonio - Chicken or the Egg?

- Codify or incentivize?
- Landscape scale or residential yard scale
- Create the market for the product or create the product and use advertising to sell the product

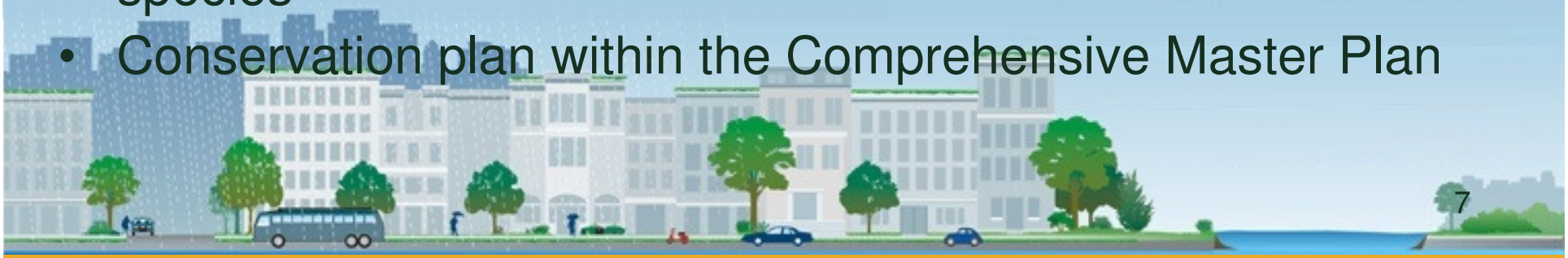
Which comes first?

Codification and Incentives

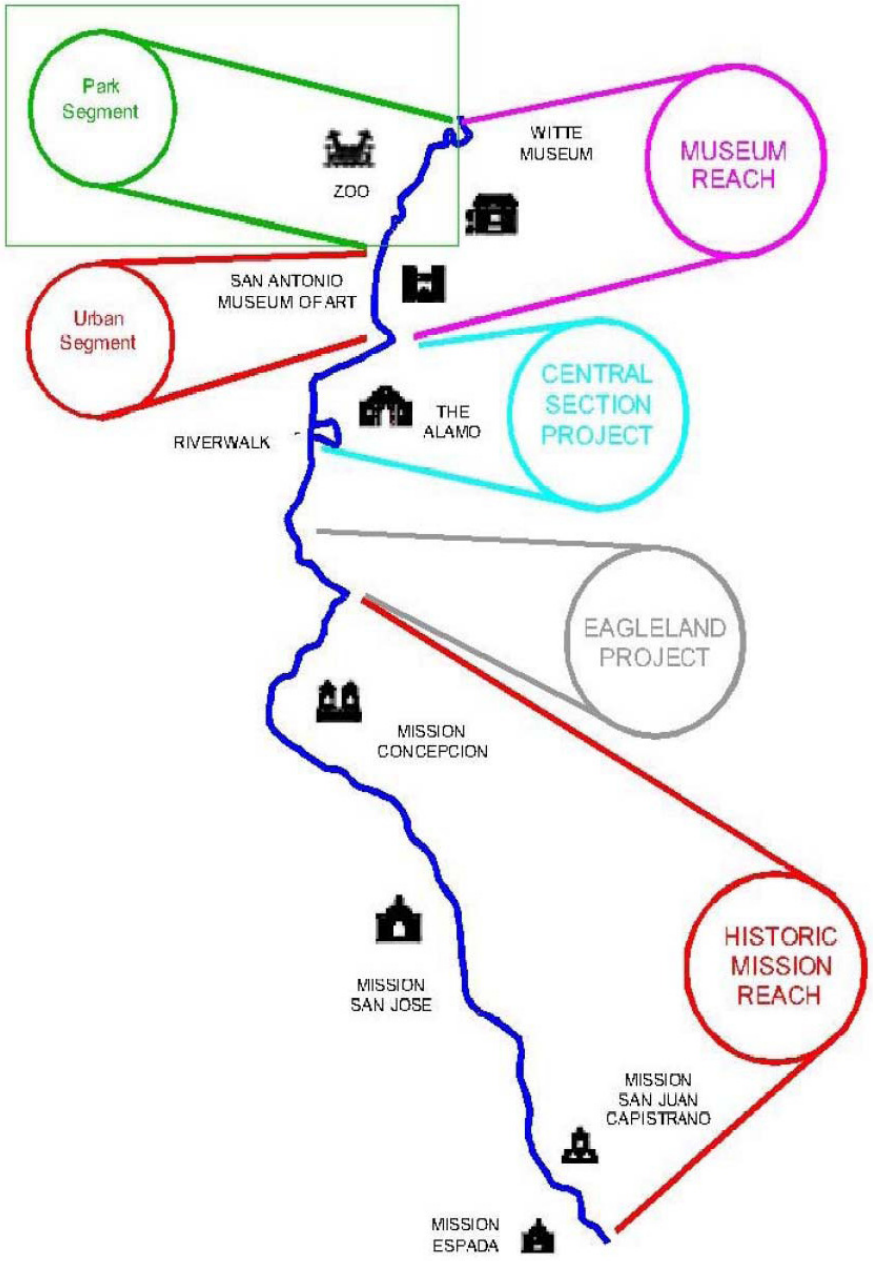
- 1994 Water Quality ordinance (aquifer protection).
- 1997 Original Tree Preservation ordinance.
- 1998 Drainage ordinance (stormwater control).
- 2001 UDC revised to enable mix use, conservation subdivision, infill development, etc. with incentives
- 2003 Tree Preservation ordinance standards are strengthened with incentives for tree canopy areas.
- 2008 Energy code
- 2009 Form Base Zoning District code with incentives and Dark Skies initiative

Landscape Scale

- Prop1 and 3 initiatives secures preservation which include:
  - Preservation areas over the Edward's Aquifer Recharge
  - Riparian buffers for hike and bike along creeks and rivers that provides linkages
- Parks that protect major floodplain and steep slope areas such as MLK, Brackenridge, OP Schnabel, Walker Ranch, Friedrich and Medina River parks
- 2007 beginning of the San Antonio Mission Reach River Improvement project
- 2008 Tree Canopy Analysis
- Regional habitat conservation plan targeting endangered species
- Conservation plan within the Comprehensive Master Plan



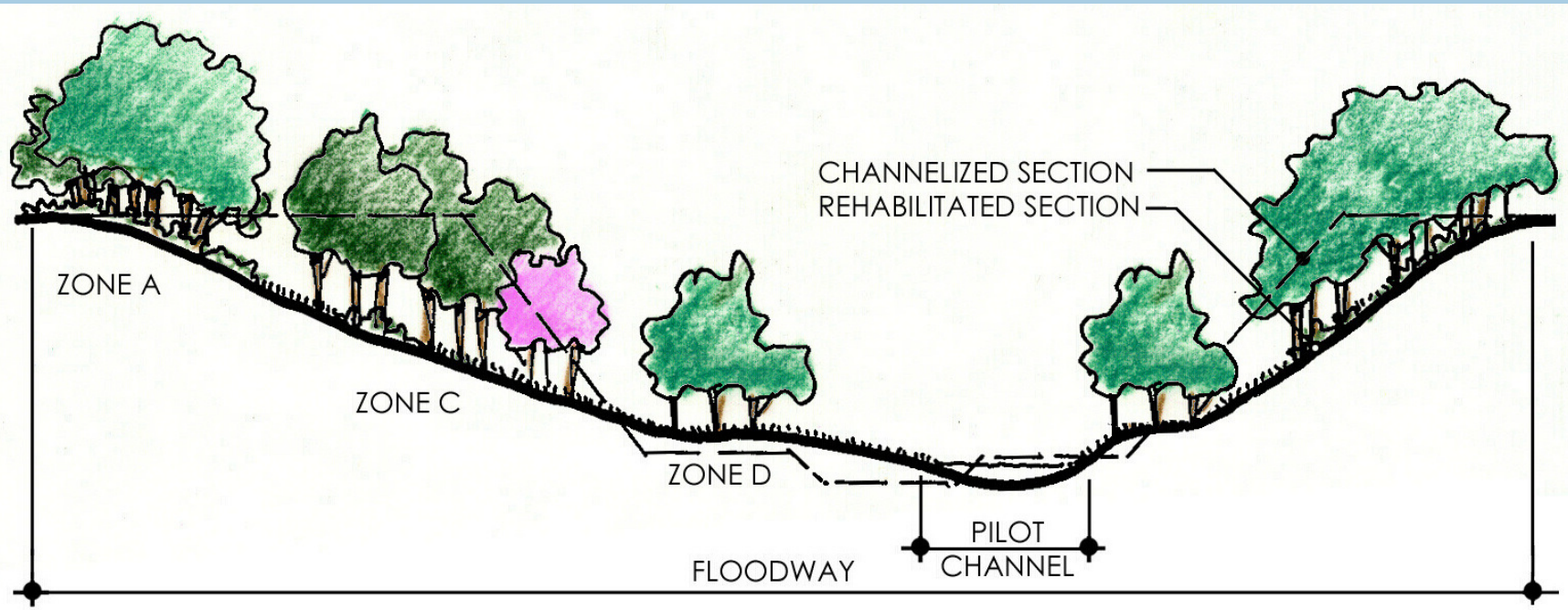
Hike and Bike Trails through Urban and “Natural Areas” provide landscape scale linkages for people, fauna, flora and culture



San Antonio River Improvement Project also provides linkages for people, plants, wildlife and culture while linking urban, and rural areas

San Antonio River "Restoration" Project – the Mission Reach Portion

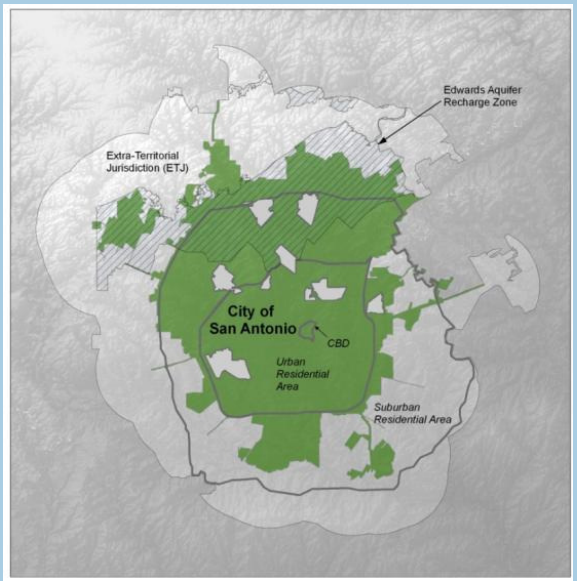
also provides these landscape scale linkages with ecological benefits – 20,000 new trees to be planted



VEGETATION IS DIVIDED INTO ZONES WITH PREDEICTABLE INFLUENCES ON FLOOD WATER CONVEYANCE. VEGETATION AND FLOODWATER CAPACITY OF THE FLOODWAY ARE BALANCED TO PROVIDE WILDLIFE HABITAT, A DESIRABLE PLACE FOR PEOPLE, AND FLOOD PROTECTION.

VEGETATION AND HYDRAULICS

San Antonio 2008 Tree Canopy Study is a landscape scale study of trees and their ecological services



Landsat data used for trend analysis and 2' resolution aerial imagery for tree canopy percentages

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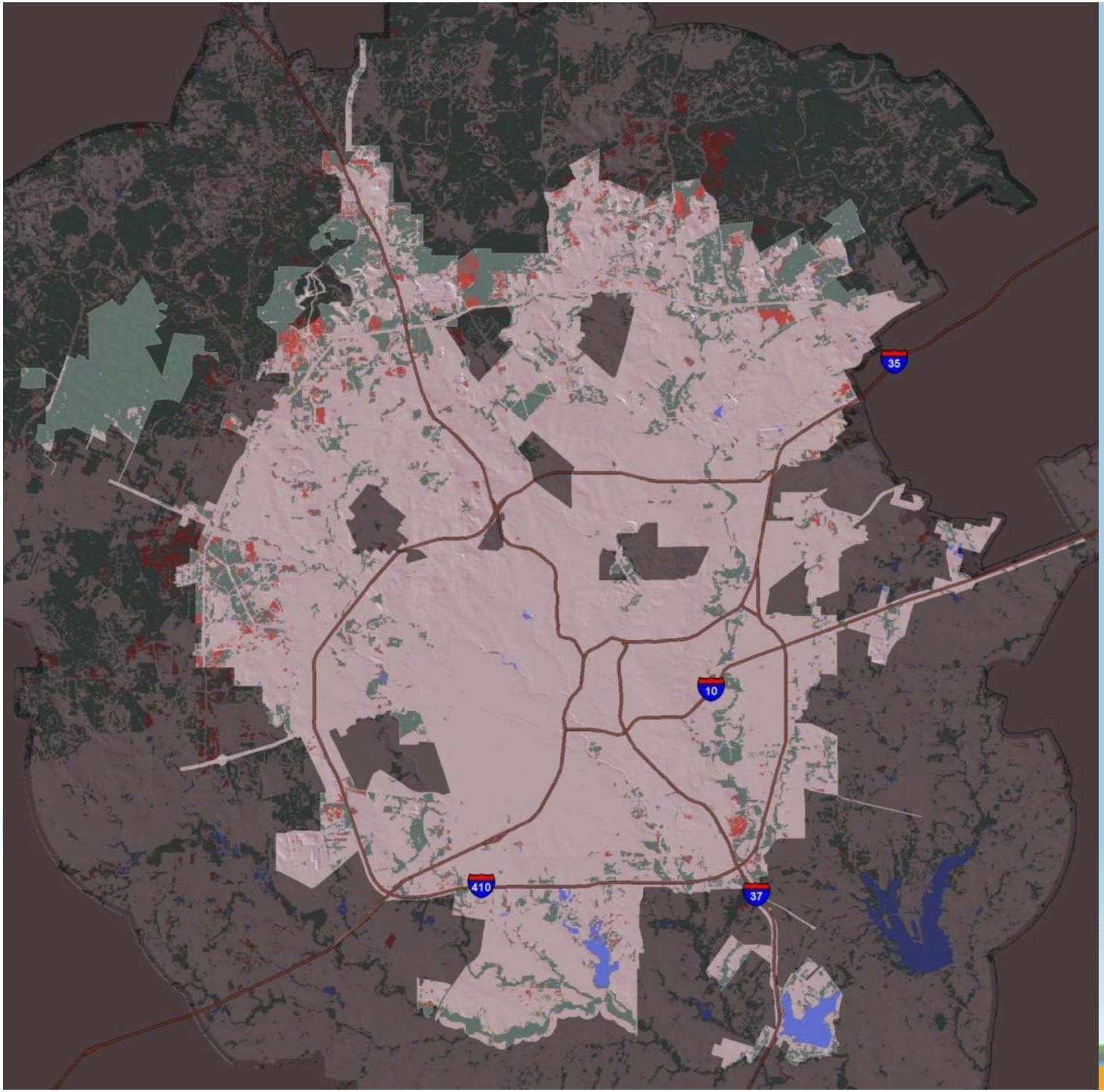
SANBORN



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City of San Antonio

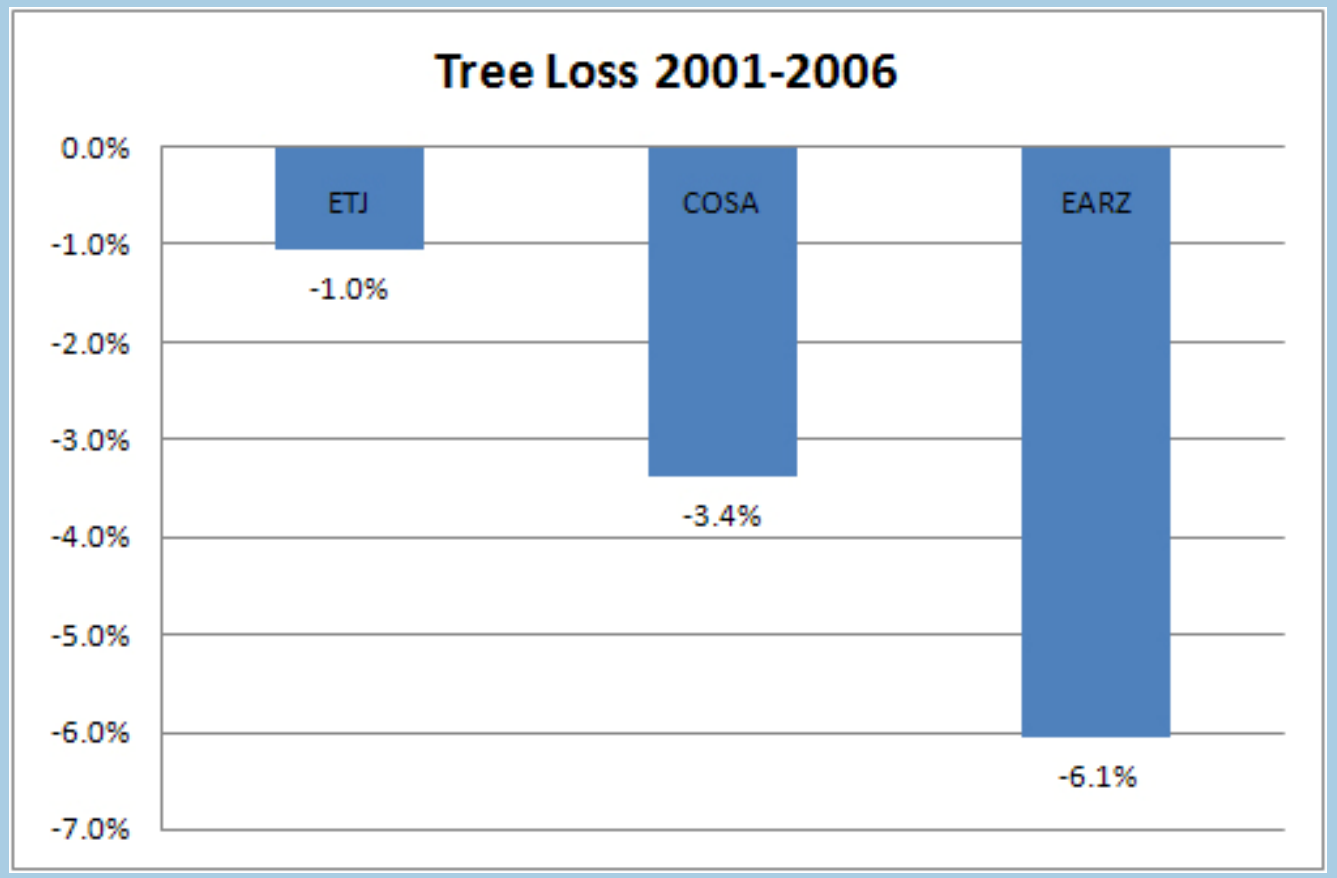
Landsat Analysis

Tree Canopy Loss
2001 - 2006

Forest Loss (2001-2006)
Forest Gain (2001-2006)
Forest (No Change)
Water

Landcover Changes 2001-2006

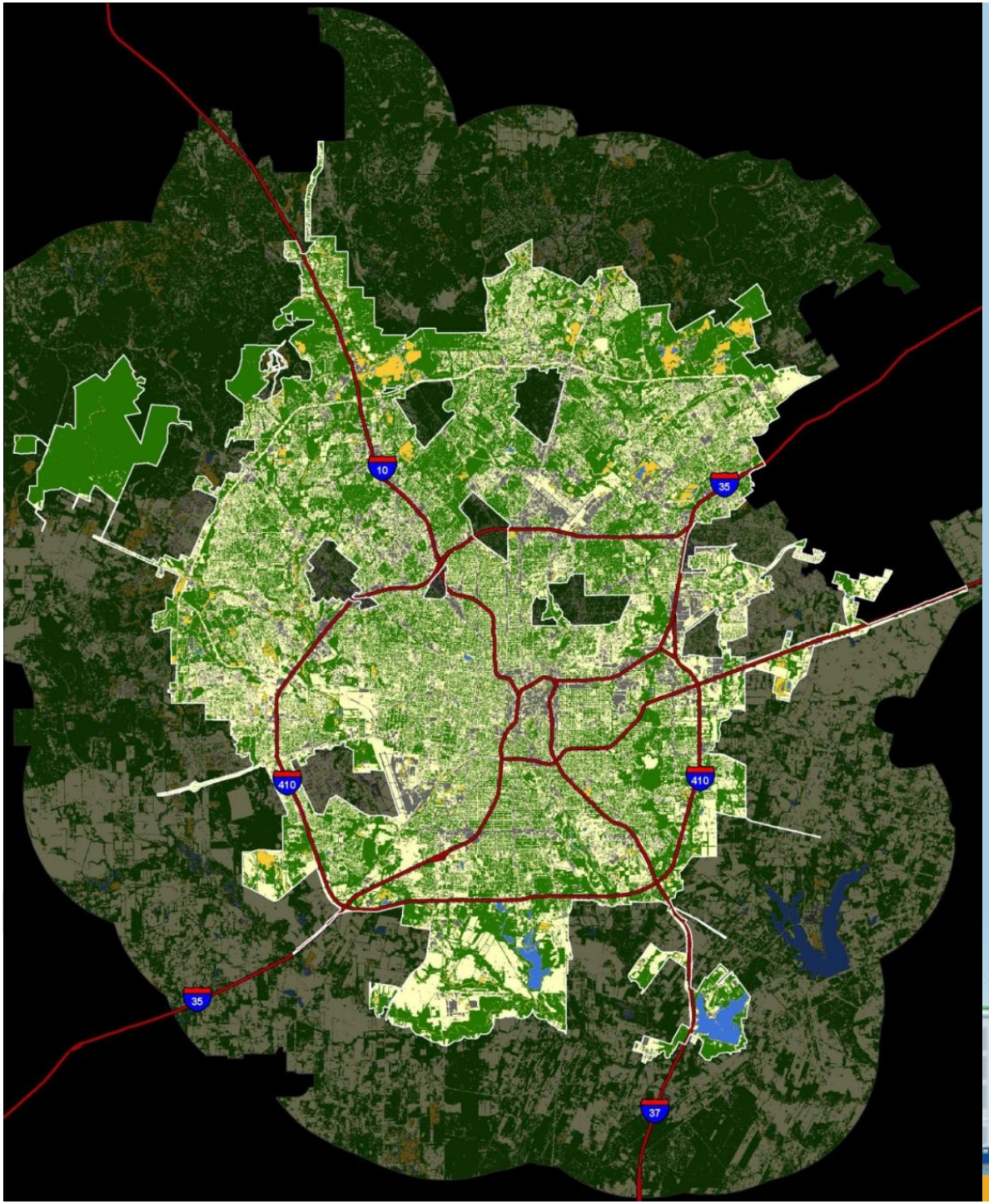
Table 1. San Antonio Landsat Data Changes over time									
Landcover	**ETJ**			**City of San Antonio**			**Edwards Aquifer**		
	Acres			**Acres**			**Acres**		
	2001	**2006**	**% change**	**2001**	**2006**	**% change**	**2001**	**2006**	**% change**
Trees	222,196	219,688	-1.1%	54,420	52,587	-3.4%	53,443	50,236	-6.0%
Open Space/grasslands	409,707	393,588	-3.9%	111,867	104,225	-6.8%	41,193	36,767	-10.7%
Urban	152,760	167,280	9.5%	128,198	135,637	5.8%	29,565	35,527	20.2%
Bare	3,398	7,658	125.4%	1,733	3,861	122.8%	1,538	3,198	107.9%
Water	7,507	7,278	-3.0%	2,545	2,459	-3.4%	121	121	0.0%


Tree Loss 2001-2006
0.0%
-1.0%
-2.0%
-3.0%
-4.0%
-5.0%
-6.0%
-7.0%
ETJ
-1.0%
COSA
-3.4%
EARZ
-6.1%

Loss in Ecosystem Benefits

2001-2006	Tree Canopy Change	Loss of Air Pollution Removal	Loss of Air Pollution Removal Value	Loss in Stormwater Value	Loss in Storm water Value@ $.32/cu ft.	Loss of Carbon Stored	Loss of Carbon Sequest-ered
	%	lbs./yr	dollar value	cu. ft.	dollar value	tons	tons
ETJ	-1.2%	-295,714	-$704,327	-93,036,121	-$29,771,559	-113,295	-882
COSA	-3.4%	-205,968	-$490,572	-57,957,865	-$18,546,517	-78,911	-614
EARZ	-6.0%	-360,132	-$857,757	-40,652,214	-$13,008,709	-137,975	-1,074

City of San Antonio



- Impervious Surfaces
- Open Space (Grass/Scattered Trees)
- Trees
- Urban: Bare
- Water

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2007 Landcover

Table 3. San Antonio 2007 High Resolution Data of Landcover								
	ETJ		Edwards Aquifer		Citywide		City South	
Landcover	2007 Acres	% Land-cover	2007 Acres	% Land-cover	2007 Acres	% Land-cover	2007 Acres	% Land-cover
Trees*	315,572	41.4%	66,903	55.0%	113,011	37.8%	17,399	35.9%
Open space: Grass/scattered trees	302,333	39.7%	24,516	20.0%	84,290	28.2%	26,730	55.2%
Impervious	109,954	14.4%	23,692	19.5%	88,366	29.6%	2,283	4.7%
Urban: Bare soil	23,609	3.1%	6,206	5.1%	9,544	3.2%	616	1.3%
Water	9,886	1.3%	373	0.30%	3,366	1.1%	1,388	2.9%
Total Acres	761,354	100%	121,690	100%	298,577	100%	48,415	100%
Canopy %	**41%**		**55%**		**38%**		**36%**	

2007 Ecosystem Services by Land Use Areas

	Air Pollution Removal	Air Pollution Removal Value	Carbon Stored	Carbon Sequest-ered	Stormwater Value	Stormwater Value @ $.32 per cu. ft
	lbs./ yr	dollar value	tons	tons	cu. ft.	dollar value
Urban Res	3,883,518	$9,249,691	1,487,866	11,583	327,368,176	$104,757,816
Suburban Res	9,595,751	$22,854,981	3,676,355	28,621	702,596,006	$224,830,722
CBD	14,763	$35,162	5,656	44	1,824,932	$583,978
Commercial	1,001,331	$2,384,951	383,633	2,987	83,795,961	$26,814,708

Recommended Tree Canopy Percentage per Land Use and Areas

Table 6. San Antonio Ecosystem Benefits of Modeled Recommended Tree Canopy Percentages					
	Citywide	CBD	Urban Res.	Suburban Res.	Commercial
Landcover	% Landcover	% Landcover	% Landcover	% Landcover	% Landcover
Canopy %	38%	12%	32%	33%	13%
AF Recommended Canopy %	40%	15%	35%	45%	20%
Difference in Canopy %	-2%	-3%	-3%	-12%	-7%

Added Value of Increased Tree Canopy Percentage

Table 7. Additional Benefits of Modeled San Antonio Ecosystem Services								
Land Use	**Increase in tree canopy**	**# of trees represented by an increase in canopy percentage***	**Additional Air Pollution Removal**	**Additional Air Pollution Removal Value**	**Additional Carbon Stored**	**Additional Carbon Sequest-ered**	**Decreased Stormwater Volume**	**Additional Stormwater Value @ $.32 per cu. ft**
	percent		lbs./ yr	dollar value	tons	tons	cu. ft.	dollar value
COSA	2%	454,600	721,121	$ 1,717,553	276,278	2,151	3,358,739	$ 1,074,797
Urban res.	3%	245,500	341,783	$ 814,052	130,945	1,019	2,691,324	$ 861,224
Suburban res.	12%	2,368,600	3,510,573	$ 8,361,417	1,344,982	10,471	5,883,003	$ 1,882,561
CBD	3%	2,400	3,202	$ 7,626	1,227	10	4,183	$ 1,339
Commercial	7%	361,200	521,614	$ 1,242,371	199,842	1,556	2,880,229	$ 921,673

Site Scale - Basic Principles

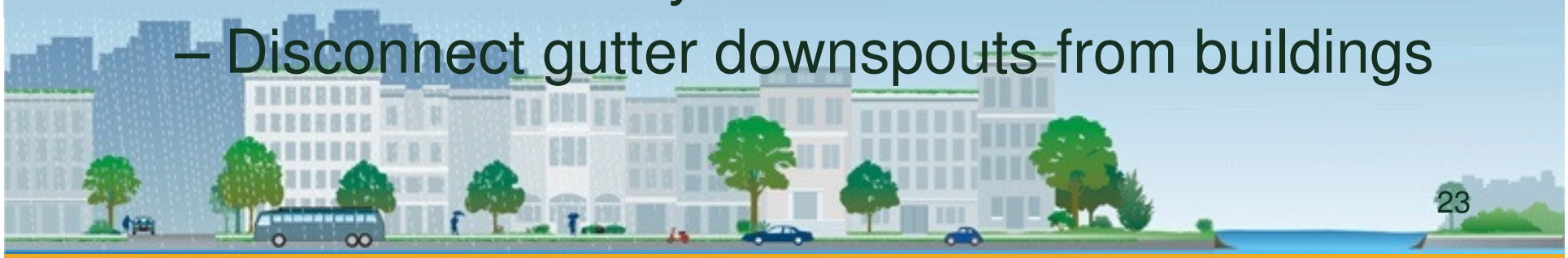
- Design to connect green spaces
- Preserve when possible including understory vegetation
- Collaborate between disciplines
- Treat water as a resource, not a waste product
- Design to mimic or replicate the natural hydrology of a site
- Design to address issues of water quality and quantity, aesthetics and amenities
- Infiltrate, detain, retain
- Accommodate the standards and expectations of the client and the local community

Steps in Site Development

- Site Assessment
  - Existing topography/drainage
  - Existing soils
  - Existing trees to meet Tree Preservation ordinance
- Building and parking design
- Drainage design for entire site to meet drainage requirements
- Create landscape plan to use preserved tree and to meet Landscape ordinance requirements

Use of Site Scale Integrated Management Practices

- Site – combine drainage and landscape areas to meet code requirements
  - Preserve “natural” areas to capture and infiltrate stormwater
  - Create infiltration areas
- Building
  - Landscaped roofs
  - Rain collection systems
  - Disconnect gutter downspouts from buildings



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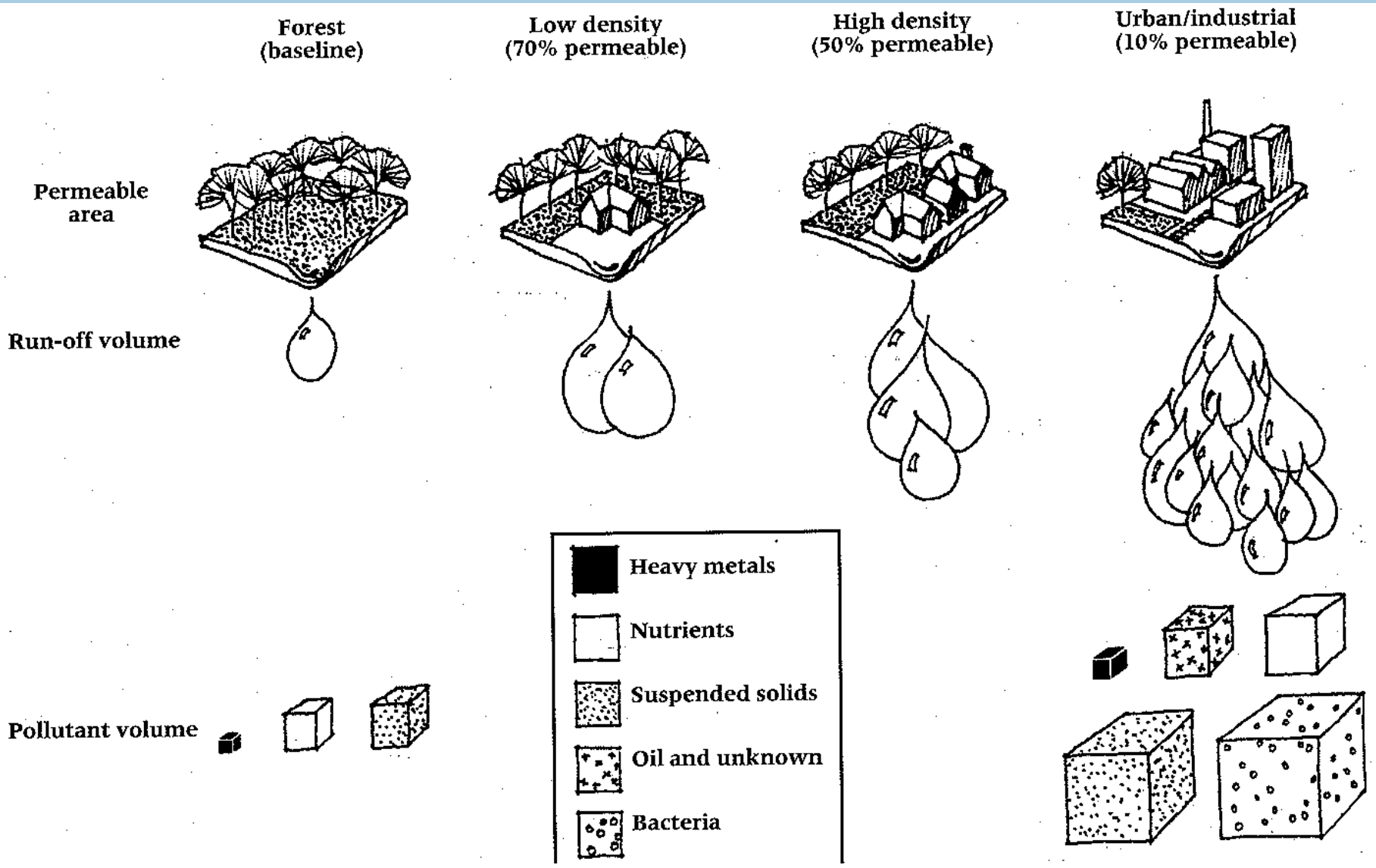
On a site scale we can see the impact of development on hydrology



Low Impact Development is an approach that applies to the Site Scale

At the Site Scale Preserve Existing Vegetation for Drainage, Landscape and Habitat

Tree Save areas offer instant landscape and play areas with shade

Tree Save areas provide management for stormwater quantity and quality

Create New Infiltration Areas

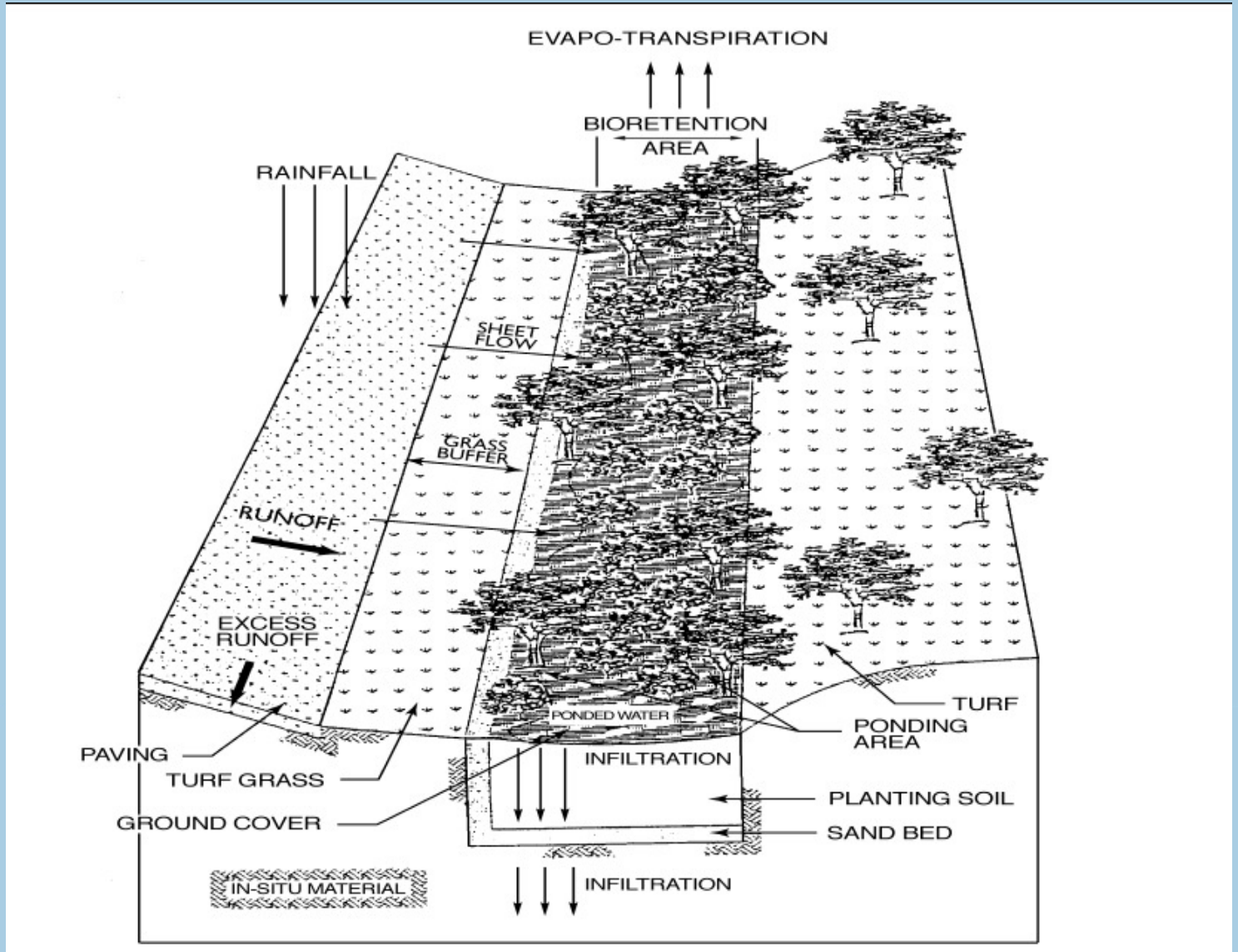
- Swales
- Bioretention areas
- Rain Gardens
- Landscape infiltration trenches/strips
- Porous pavement
- Structured tree boxes

Swales

A LID swale (below) has an engineered design to increase infiltration such with use of “structured” soils or an underdrain.

Grassed drainage channels (above) are not engineered to provide infiltration. They primarily serve to convey water

Bioretention and Filtration



Bioretention and or Filtration

Landscape Strips with Sawtooth Curb

Grade of parking lot directs stormwater to this infiltration area reducing the amount of stormwater that is directed by curb and gutters to the storm sewer which connects to the creek

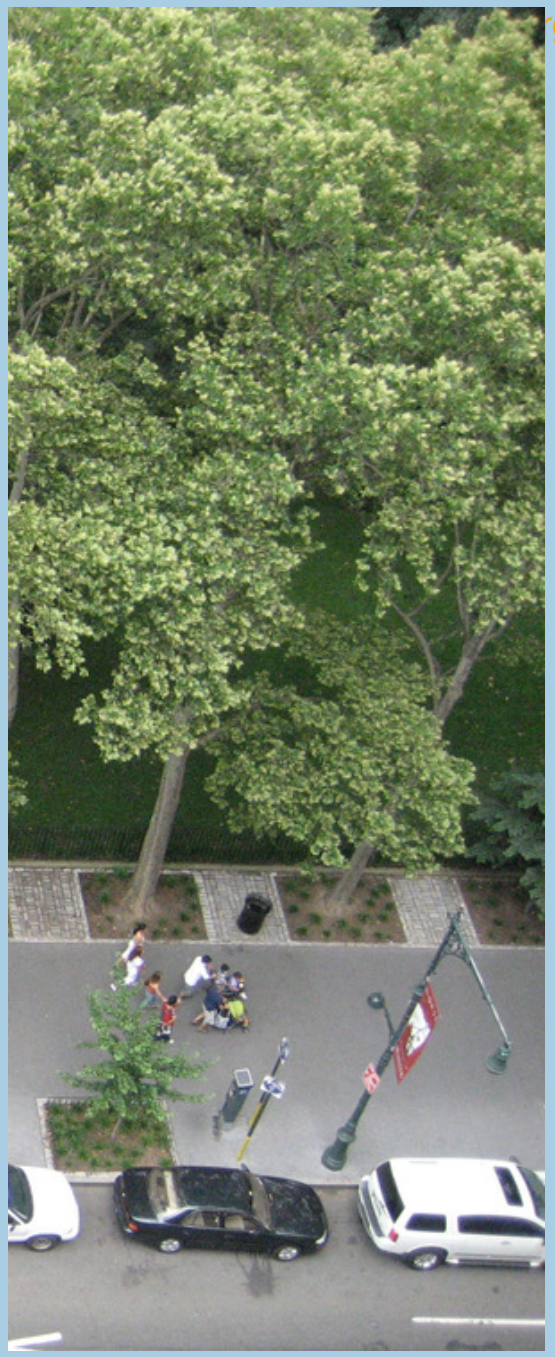
Landscape Infiltration Strips for Inner City Sites

Infiltration Trench and Porous Pavers

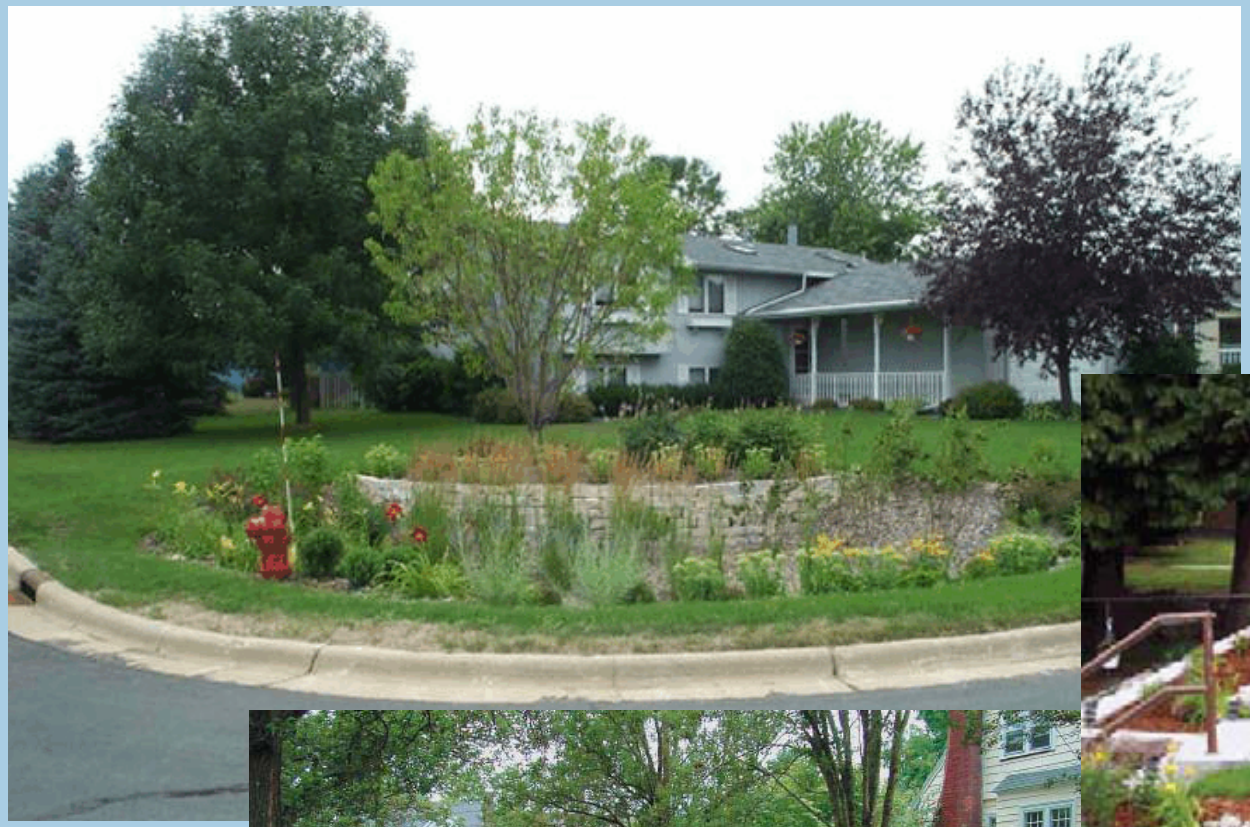
Green Alleys

Streetscapes that capture and filter stormwater

Use of Tree Areas and Gravel Drains



Rain Gardens and Street Landscape Strips



Treatments for Small Areas

Filterra® and Bacterra™ Stormwater Bioretention Filtration Systems

Total suspended solids, phosphorus and bacteria treatment

Building Considerations

- Landscaped Roofs
- Rain Harvesting
- Disconnecting gutters

A roof that is planted with vegetation can capture, store and use stormwater while reducing energy use of a building and providing an amenity

Rain Harvesting

Rain Barrels

Storage in a
limited space

Cistern

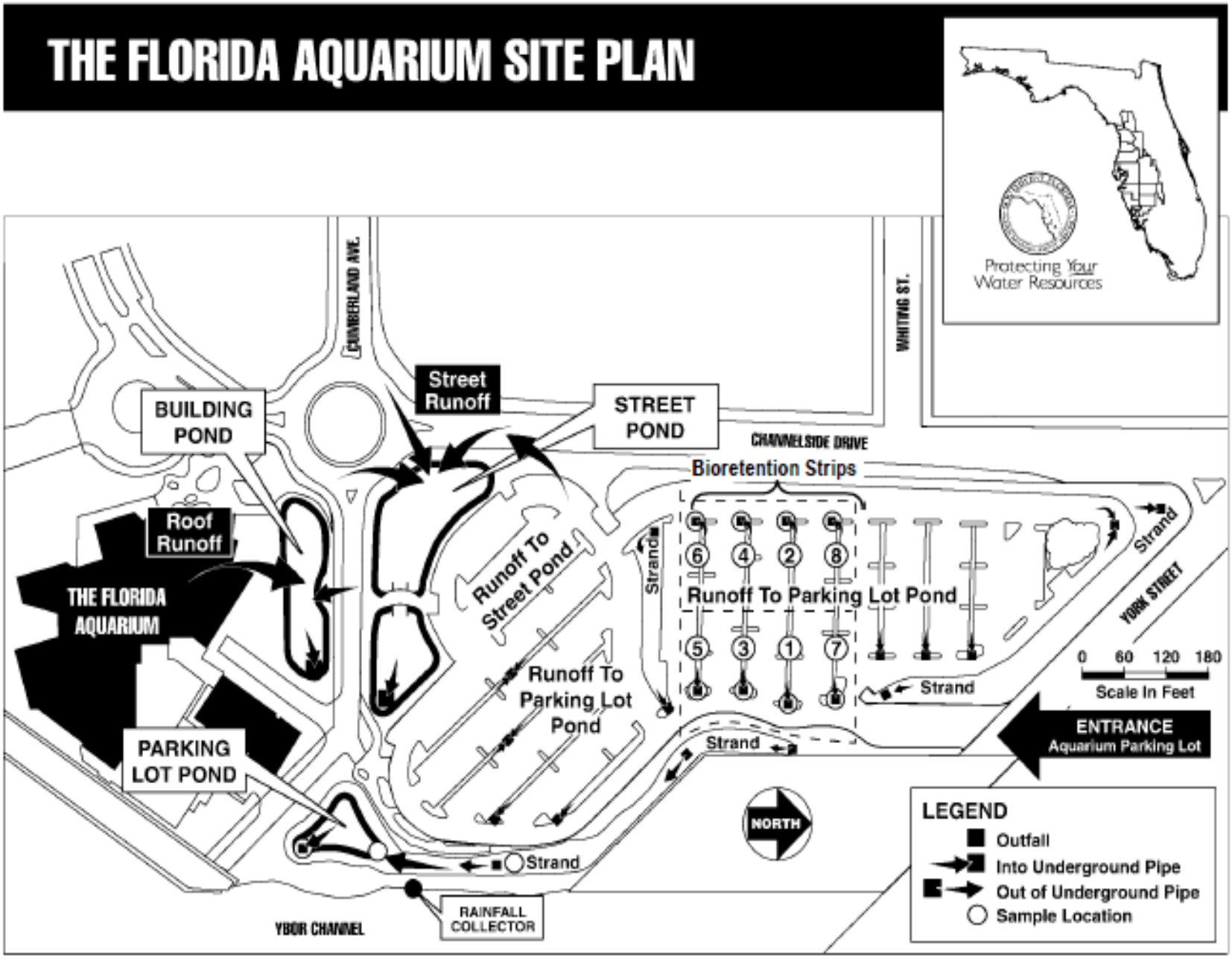


Figure 2. Layout of the Florida Aquarium site with IMPs. The eight basins outlined with dotted lines were evaluated in this part of the study.

Improving on Site Specific Green Infrastructure

- Removing impervious area
- Restoring stability and ecological function to your local creeks
- Creating and restoring habitat

Downtown Central Library

Original landscape of Bradford Pear trees planted in 2' strips – died.

Project Partners: COSA, SAWS, CPS Energy and Alamo Forest Partnership

Removed alternate sidewalks to increase planting areas to 22' wide:

Condensate collection system installed for irrigation.

Xeriscape trees and plants installed and maintained with mulch.

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Salado Creek Bioengineering project before and June 2006

Project Partners:

EPA, NRCS, COSA

Improve Wildlife Habitat: Orlando, FL

"Wetlands" creation and restoration

Greenwood Urban Wetlands

The Green Infrastructure – Landscape Scale

Texas Trees Foundation

Green vs.

Gray

Infrastructure